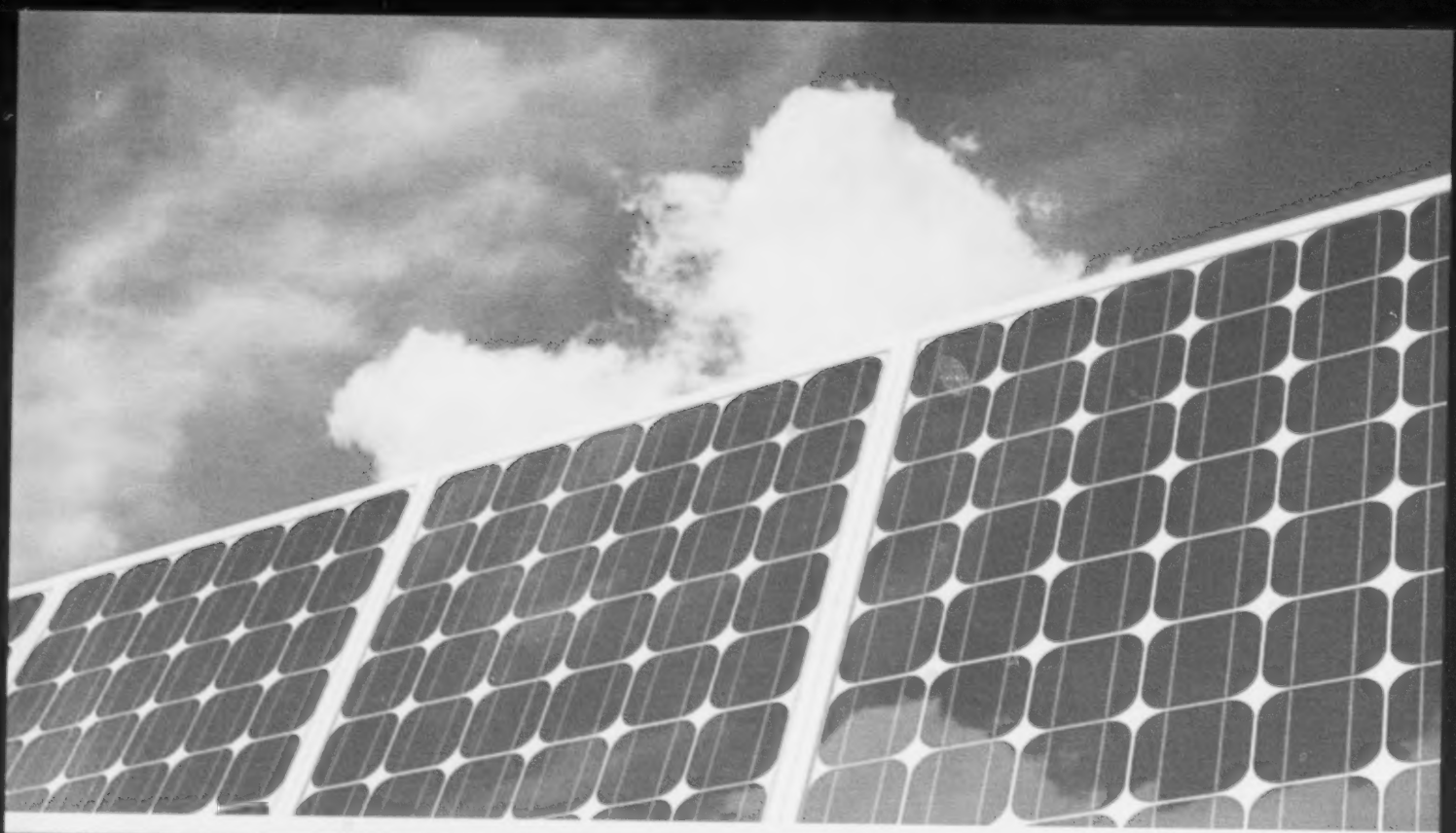
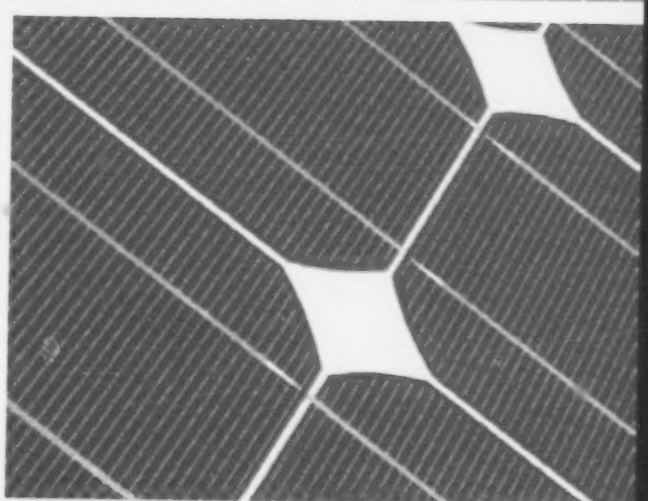


Northwest Territories Solar Energy Strategy 2012 2017



Northwest Territories Environment and Natural Resources

Message from the Minister

The Government of the Northwest Territories continues to work with communities, industry and businesses to identify ways to reduce our dependence on fossil fuels and the costs of living, working and doing business here.

Solar energy technologies are identified in the NWT Greenhouse Gas Strategy 2011-2015 as a measure to help limit and reduce our emissions. These technologies are proving to be a viable alternative to diesel energy for some residents, businesses and communities. The costs of these technologies are becoming more affordable every day.

Battery-based solar charging systems have proven to be an economical way to provide reliable electricity in camps, lodges and homes in remote locations not connected to community power grids. Residents and businesses have installed more than 200 of these off-grid systems. Solar hot water heating systems are also gaining popularity for seasonal applications such as heating water in community pools and for showers at Territorial Park facilities.

The current challenge is to incorporate solar photovoltaic energy into the community grid system to offset diesel generation. Already, 25 grid-connected solar photovoltaic systems have been installed in the NWT, but more can be done to maximize the environmental and economic benefits of solar energy generation.

This Solar Energy Strategy outlines the steps and actions to help the NWT take advantage of solar energy opportunities during the next five years.

The Strategy establishes a bold target of displacing 10 percent of diesel electricity generation in the NWT. Achieving this target requires the commitment and active participation of governments, communities, businesses and industry. It can be accomplished through residential, commercial and power utility company installations feeding into the existing power grid. The main focus is on communities currently using diesel energy as this provides the best value for investing in solar technology solutions.

Working with communities, businesses and industry, we can encourage the use of solar technologies and build experience with these systems, while reducing our energy costs and our greenhouse gas emissions.

J. Michael Miltenberger
Minister
Environment and Natural Resources

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Front Cover, bottom right: Whati Store. 5 kW Dual Axis Tracker. Installed 2012 – Photo Credit: Matthew Brost
Back Cover, left: Nahanni Butte Community Gym. 4.8 kW Grid Interconnected. Installed 2011 – Photo Credit: Matthew Brost

Vision

Promote the use of solar energy technology and reduce the consumption of, and reliance on, fossil fuels for electricity generation in the NWT.

Purpose

The Strategy guides the Government of the Northwest Territories' (GNWT) actions to promote the use of solar energy technologies in the Northwest Territories (NWT).

The Department of Environment and Natural Resources (ENR) is responsible for coordinating actions described in the Strategy. ENR will work with other GNWT departments, power utility companies, communities, businesses and consumers to implement all actions, and finance actions that are particularly resource intensive.

This Strategy is part of overall actions currently underway to support the targets and goals of the *NWT Energy Plan* and *A Greenhouse Gas Strategy for the Northwest Territories 2011-2015* (Greenhouse Gas Strategy), including reduced dependence on imported fossil fuels by developing local renewable energy sources in ways that reduce greenhouse gas emissions.

Objectives

1. Increase education and awareness of solar energy technologies for residents, businesses, communities, government departments and public power utility companies.
2. Develop policies and guidelines to reduce institutional barriers to solar energy technology deployment in the NWT.
3. Assist public power utility companies to advance solar-diesel hybrid systems in communities.
4. Promote the use of battery-based solar charging systems in remote 'off-grid' applications.
5. Increase the monitoring of solar energy systems to measure and assess their performance.

Target

Working with communities, industry and businesses, install solar systems with the capability to supply up to 20 percent of the average load in NWT diesel communities.

Fort Simpson, NTPC 60 kW Array, Installed 2011 – Photo Credit: Melanie Burgess

Solar Energy in the Northwest Territories

The use of modern solar technologies in the NWT dates back to the early 1980s. Cabin owners realized a battery could be charged with a solar photovoltaic (PV) panel during the long summer days. When the sun was blocked by clouds or dipped behind trees in the evening, the battery had enough stored "sun" energy to operate a cabin's radio and lighting until the next day.

Solar panels were relatively new and expensive technology in the 1980s. Even off-grid cabin owners found solar power, despite the expense, was a reliable way to produce usable electricity without the noise and pollution associated with the operation of a traditional diesel generator.

Solar charging systems, combining PV panels with battery storage and generator back-up, are now the most economical way to provide reliable electricity in remote camps, lodges and off-grid homes.

There has been an increase in the use of 'grid-connected' solar systems during the past few years. These systems provide power and, when solar energy is not available, power is purchased from the grid. Grid interconnection standards ensure safety and power reliability is not compromised. A Net-billing Pilot Project now underway in the NWT allows customers to connect private PV systems to the grid and sell surplus power generated back to the power utility.

Solar energy technologies are already being used in the NWT for battery-based, off-grid, remote solar applications and grid-connected systems. These systems are operated by residents, businesses, community organizations and Aboriginal development corporations as well as the Northwest Territories Power Corporation (NTPC).

New solar PV panels continue to function for more than 30 years, with an estimated decline in power production of about one percent a year. At current prices, these are cost effective in remote locations. As prices continue to drop, solar PV panels are becoming competitive with the cost of diesel generation.

Solar energy is also being used for passive solar heating of buildings, solar air preheating and solar hot water heating. Buildings with south facing windows use passive solar heating to effectively reduce energy costs during all four seasons.

Solar technologies for heating are also used to augment domestic hot water, preheat air and heat water in five swimming pools in the NWT.

The future use of renewable energies such as solar, hydro, biomass, geothermal and wind in any community depends on what is available at that location and which technology is most cost effective. The Ministers' Energy and Climate Change Coordinating Committee will continue to identify GNWT priorities as defined through the *NWT Energy Plan* and the Greenhouse Gas Strategy. This Strategy defines solar opportunities in the NWT.

Edzo Youth Centre, 5 kW Dual Axis Tracker, Installed 2012 – Photo Credit: Matthew Brost

NWT Solar Potential

Harnessing solar energy in the NWT may seem unlikely. The short and dark days of winter provide little or no usable energy, depending on the latitude in the NWT. However, the long hours of sunlight in spring and summer can provide usable heat and electricity for up to eight months of the year.

According to Natural Resources Canada, the annual solar resource in the NWT is higher than Germany and Japan, and comparable to most of Ontario. For solar PV systems, this translates into electrical generation of between 800 and 1,200 kilowatt hours per installed kilowatt every year.

Harnessing usable energy from the sun does not require warm weather. It requires sunshine. Solar PV systems perform better in lower temperatures. They become less efficient as they get hotter. Solar heating technologies using glycol loops and heat exchangers can preheat water even if the outside temperature is below zero.

Roger Kuptana, Polar Griz Lodge, Sachs Harbour, 4.3 kW Grid Interconnected, Installed 2010 - Photo Credit: Randall Benson

As a first step toward encouraging broader use of renewable energy, the GNWT initiated an incentive program (AETP, 2007) to help residents, businesses and communities purchase and install solar technologies.

Canada Excellent Solar Resource

Credit: Natural Resources Canada

1. Regway SK, 1384
2. Wild Horse AB, 1373
3. Waskada MB, 1370
4. Rainy River ON, 1265
5. Elkford BC, 1236
6. Quyon QC, 1208
7. Chatham NB, 1168
8. Chesterfield Inlet NU, 1158
9. Mirminegash PE, 1136
10. Fort Smith NT, 1126
11. Amherst NS, 1125
12. Wabush NF, 1074
13. Burwash Landing YT, 1056

SOLAR TERMS:

Available Solar Energy is the amount of radiant light and heat from the sun reaching the earth. The amount of sunlight available in a particular location depends on a number of factors, including latitude, time of day, time of year, shading and cloud cover.

Passive Solar is a design strategy using available solar energy for heating without using mechanical systems or any external energy input.

Passive solar strategies include architectural features, such as building design, orientation and window placement, to convert sunlight into usable heat. Passive design can be used to move air for ventilation, cooling or storing heat for future use.

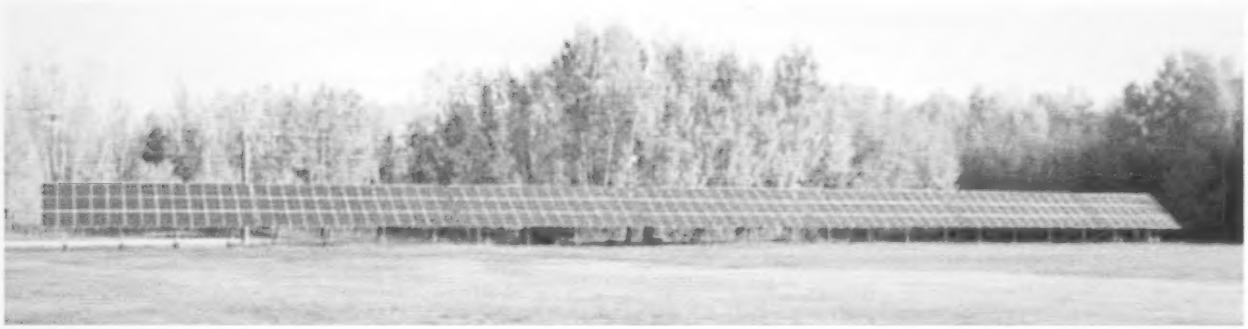
Active Solar involves the use of technology and equipment to transform solar energy into usable electricity or heat. These processes are:

- **Solar Electricity:** Solar energy used for generating electricity is known as **solar PV**. PV stands for "**photovoltaic**" or the process of turning light (photo) into electricity (voltaic). This term is shortened to "**PV**".

  The equipment used for generating solar electricity may include one or more solar modules (panels) connected with wires to an inverter and electronic controls. This is often referred to as a solar array.

- **Solar Heating:** Solar energy used for space heating or preheating a domestic water supply is known as "**solar thermal**". This method captures energy from the sun and transforms it directly into heat. It is a simple and effective way of lowering dependence on oil or diesel electricity for producing hot water.

  The equipment used for solar hot water typically includes solar collectors, a heat exchanger, pumps, fans and electronic controls.



Fort Simpson, NTPC 60 kW Array, Installed 2011 – Photo Credit: Melanie Burgess

Fort Simpson, NTPC 60 kW Array, Installed 2011 (2) – Photo Credit: NTPC

Action Plan

Increasing education and awareness of solar energy for residents, businesses, communities, government departments and power utility companies.

ACTION 1:

The Arctic Energy Alliance will continue to provide energy information to both public and private sectors.

Solar energy technologies are relatively new. ENR and the Arctic Energy Alliance (AEA) often receive requests for information about setting up these systems. ENR and AEA will continue to provide basic information about these technologies and systems installed in the NWT.

The simple payback on the investment of a solar energy system depends on the specific application. It is different for each technology in each location of the NWT. Energy Specialists at the AEA can help people interested in installing solar technologies get detailed economic analysis by using RETScreen software (www.retscreen.net).

Historical trends show costs of solar technologies have decreased by 30 percent since 2009, while costs of fossil fuels continue to increase. However, the high installation costs continue to be a factor in deploying solar solutions. The economic payback of solar technologies must be re-examined annually.

ACTION 2:

Deliver Solar Energy Roundtables through the Arctic Energy Alliance.

ENR will work with the AEA to host bi-annual Solar Energy Roundtables. These roundtables will bring power utility companies, electrical inspectors and solar installers together to evaluate the technical and code aspects of permitting, approving, installing and commissioning solar energy systems in the NWT.

ACTION 3:

Establish a GNWT Interdepartmental Solar Energy Committee.

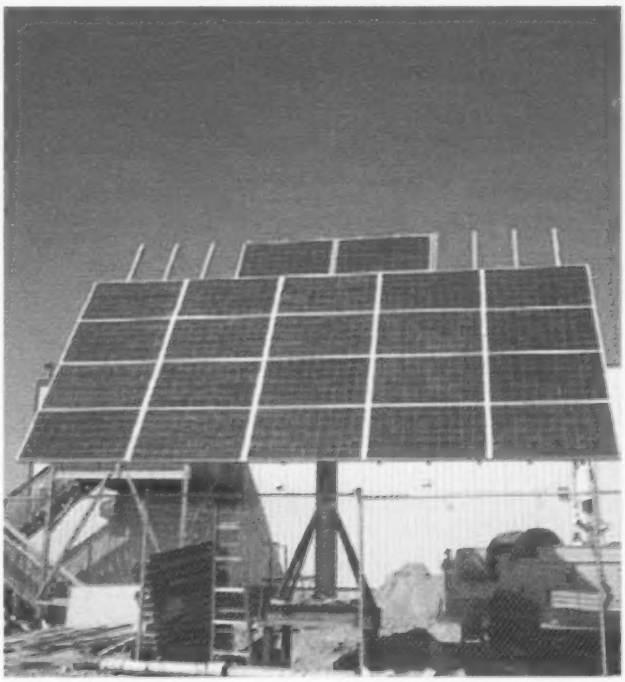
A GNWT Interdepartmental Solar Energy Committee will be established to exchange and share information on project planning, economic evaluation and operation/maintenance of solar technologies. The committee will coordinate GNWT activities in the solar sector and identify government facilities best-suited for installing solar energy technology to reduce operating costs.

ACTION 4:

Install visible solar output displays in public buildings with solar collectors.

Solar collectors are quiet and have no moving parts. It is difficult to determine if the collectors are providing energy to a building unless an output display or 'Energy Marquee' is installed. Displaying the real-time output of a solar collector provides confidence the technology is functioning. It can also provide information to the public about energy output and greenhouse gas savings.

Solar output is displayed on the power inverter where power generated from PV panels enters the grid. Inverters are usually located in areas the public cannot see. Production output can be made available on computer screens or through the internet. For example, production output of a PV system installed by the NTPC in Fort Simpson can be viewed at any time at **https://enlighten.enphaseenergy.com/public/systems/wBzY58297**



Tlicho Construction Office, 5 kW Dual Axis Tracker, Installed 2011 - Photo Credit: Matthew Brost

Develop policies and guidelines aimed at streamlining grid-interconnections and reducing institutional barriers to solar energy technology deployment in the NWT.

ACTION 5:

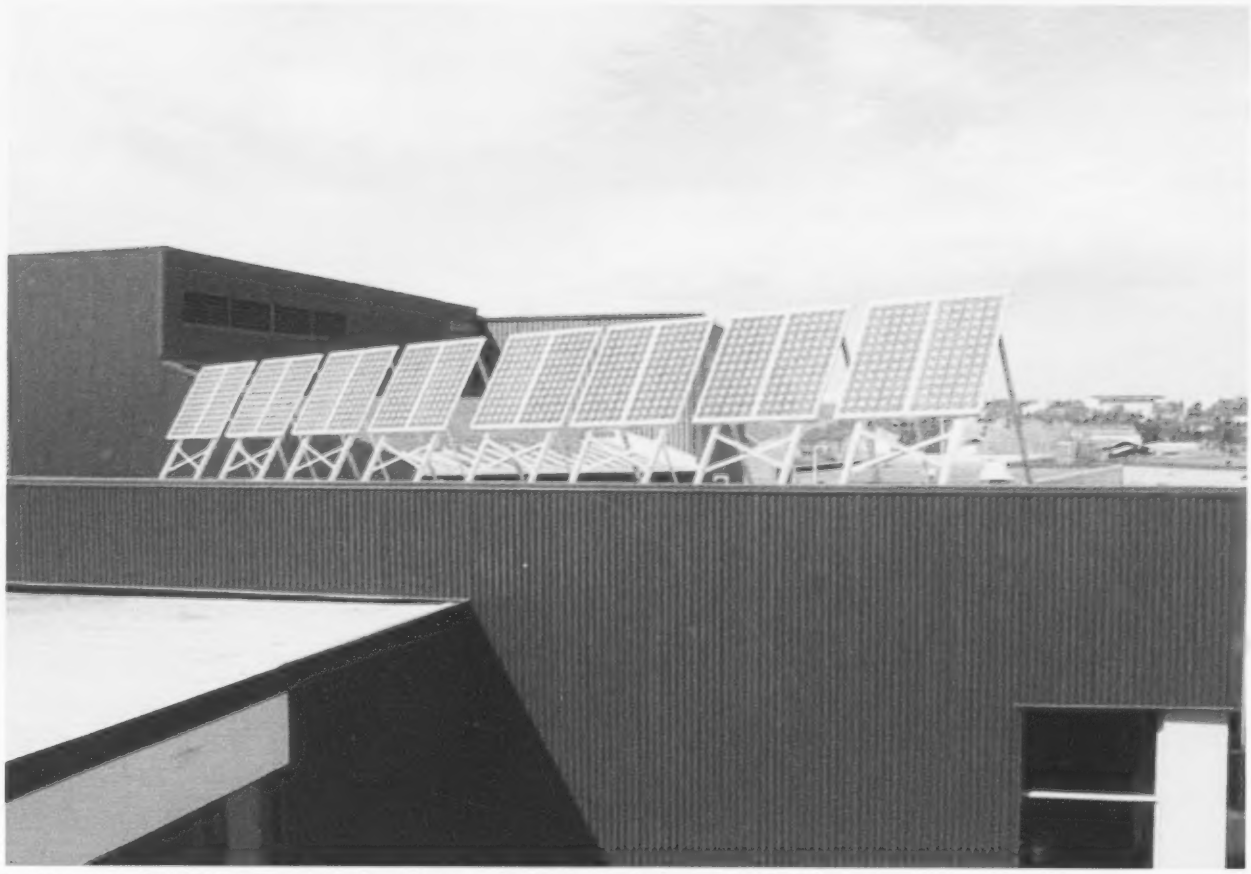
The GNWT, together with power utility companies, will develop a comprehensive program for grid-interconnected PV systems.

The GNWT and power utility companies have been testing grid-interconnected solar energy systems through a Net-billing Pilot Program. The pilot program established a process to allow NWT public power utilities to compensate customers for supplying renewable energy power into the electrical grid.

The Net-billing Pilot Program will end in March 2013. A comprehensive review of the three-year program will provide power utility companies and the GNWT with the information needed to expand and improve the program for grid-interconnected customers.

The GNWT will work with the Public Utilities Board (PUB) and power utility companies to examine opportunities for solar PV investment. This could include: discussions on options and recommendations for net-metering opportunities for homeowners and businesses; streamlined connection processes for small systems; or Power Purchase Agreements with independent operators connected to the grid.

A checklist of permitting, installation and inspection processes needs to be completed before grid-interconnected solar PV systems can be energized. The processes must be reviewed to ensure they provide the level of safety required when operating electrical systems without creating unnecessary costs or delays for solar proponents.



Sir John Franklin High School, 2 kW Grid Interconnected, First Public Grid-tie in the NWT, Installed 2003 – Photo Credit: Wade Carpenter

Assist public power utility companies to advance solar/diesel hybrid systems in communities.

ACTION 6:

Deploy solar systems sized up to 20 percent of the average load in diesel communities.

Solar PV technologies can be used in the current electrical grid if they are below about 20 percent of the average power load for the community. Control systems for solar/diesel hybrid power systems become more complex for anything above 20 percent of average load and battery storage is often required to buffer the intermittent nature of the sun's rays.

The NTPC is currently operating a 60 kW solar PV system in Fort Simpson. This successful solar/diesel hybrid system is sized to meet seven percent of the community's average load. The system is providing valuable feedback to the GNWT about the feasibility, reliability and cost effectiveness of such grid-connected installations. Since this system is owned by NTPC, any current and future cost savings can be shared with all thermal zone customers.

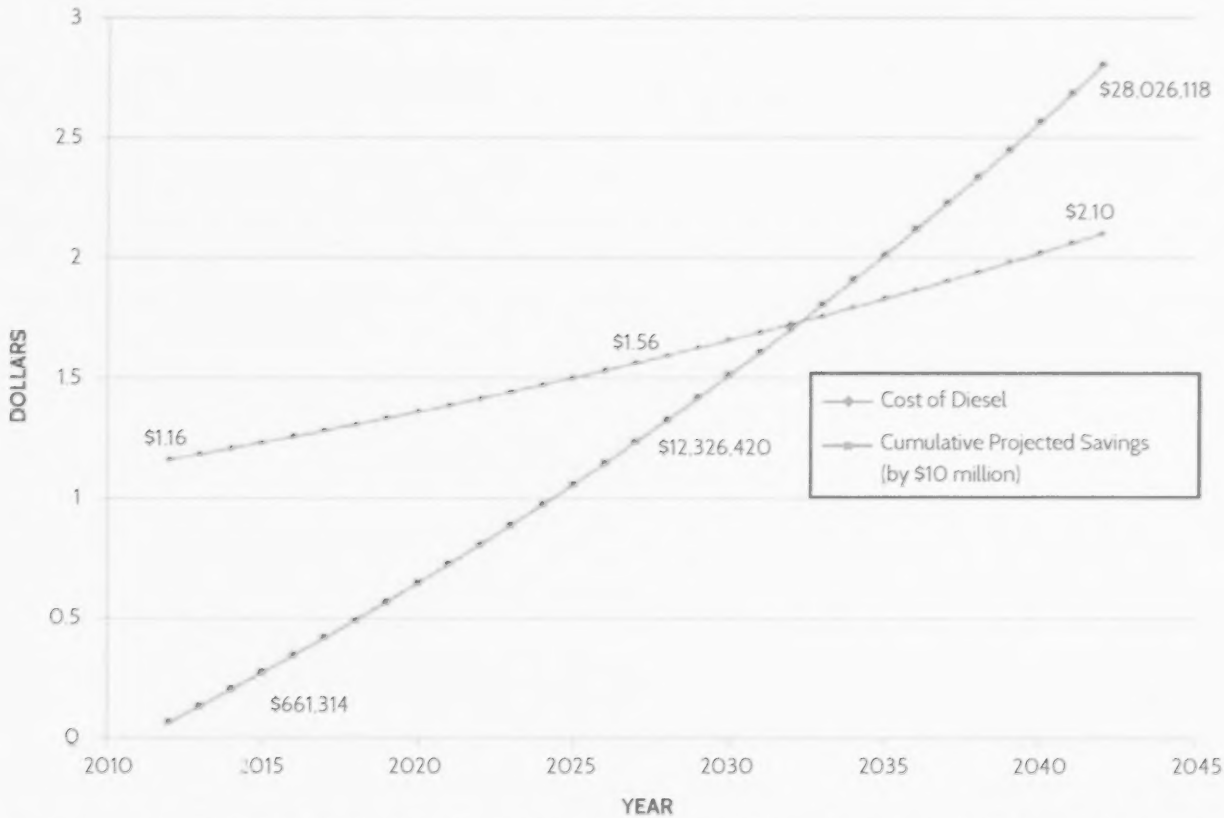
The GNWT will build on the experiences gained in communities like Fort Simpson. During the next five years, the GNWT will invest in the deployment of solar systems, sized to meet 20 percent of average community power needs, in the 25 NWT communities currently using diesel. This requires the installation of about 1.8 MW of solar capacity.

An average cost of $12 per installed watt is expected from connecting solar power into the grid in each of these communities. No energy storage solutions (batteries) would be required to achieve a 20 percent installation. The annual maintenance costs would be minimal and the system life span could exceed 30 years.

The 20 percent deployment model would yield an overall reduction of 570,000 litres per year of diesel. Assuming a two percent annual increase in the cost of diesel, the overall displaced diesel savings through this initiative would be more than $28 million over the 30-year life span.

Other benefits of this initiative include the establishment of an NWT solar industry, community-based employment opportunities, lower environmental risks associated with fuel transportation and a reduction in NWT greenhouse gas emissions of 1.6 kilotonnes (Kt) per year.

The GNWT will work with interested parties and funding partners to encourage and allow the installation of up to 20 percent of the average load in diesel communities within the next five years.



This graph shows the projected savings of deploying solar systems, sized to meet 20 percent of average community power needs, in the 25 NWT communities currently using diesel.

ACTION 7:

Investigate ways to deploy solar systems sized at up to 75 percent of the average community load in diesel communities.

Installing integrated PV systems intended to meet more than 20 percent of the average load face some hurdles. The combining of multiple complex systems sized to 75 percent of the average load has not yet been tested in the NWT. The cost of batttery storage is also high.

The GNWT needs to assess the methods and management options associated with systems sized at 75 percent.

The GNWT will install, test and monitor two such systems in the NWT during the next five years. This will assist in achieving the goal of producing at least 75 percent of the average community power needs through grid-connected solar energy.

The pilot project approach allows for the testing of system performance and limitations. It also provides valuable information needed to improve and expand use of such systems in the network throughout the NWT.

The GNWT will work with interested parties and funding partners to encourage and allow the installation of solar systems up to 75 percent of the average community load in two diesel communities within the next five years.

Solar Hot Water Heating – Photo Credit: Tom Gross

Northern Sustainable Housing Project, Inuvik. Solar PV and Solar Hot Water, Installed 2012 – Photo Credit: Wade Carpenter/GNWT

Promote the use of battery-based solar charging systems in remote 'off-grid' applications.

Rio Tinto Exploration Camp, Banks Island. Off-grid Battery Charging System, Installed 2011 – Photo Credit: Paul Jones

ACTION 8:

Continued support for off-grid solar applications.

Residents, businesses and government operations without access to grid power have traditionally used diesel or gasoline generators to power their operations. These facilities include private or commercial hunting/fishing lodges, mineral exploration/research camps, 'off-grid' cabins/homes and remote government outposts.

This is a small segment of the market compared to opportunities in communities, but it is currently the most cost effective. High transportation costs, risk of spills, high operation and maintenance costs associated with use of diesel or gasoline generators can be significantly reduced by incorporating battery-based solar charging systems in remote areas. The simple payback on the investment in a solar system can be realized in two to seven years. However, the majority of off-grid operators continue to use fossil fuel generation because battery-based solar charging systems have high upfront capital costs.

Governments use a variety of programs to help off-set the high costs of renewable energy systems. These include production incentives, tax breaks or capital grants. The GNWT provides capital grants through the Alternative Energy Technology Program (AETP) to encourage both grid-interconnected and battery-based solar charging systems. Support for this ATEP will continue.

GGL Resources, Off-grid Exploration Camp, Solar Wind Battery Charging – Photo Credit: Chris Hrkac

Increasing the monitoring of solar energy systems to better understand their long-term economic potential.

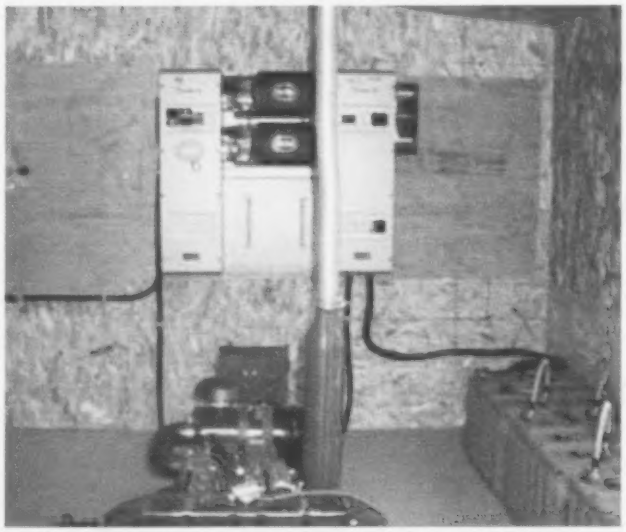
ACTION 9:

Develop an NWT Solar Energy Monitoring Program for solar technology deployment in the NWT.

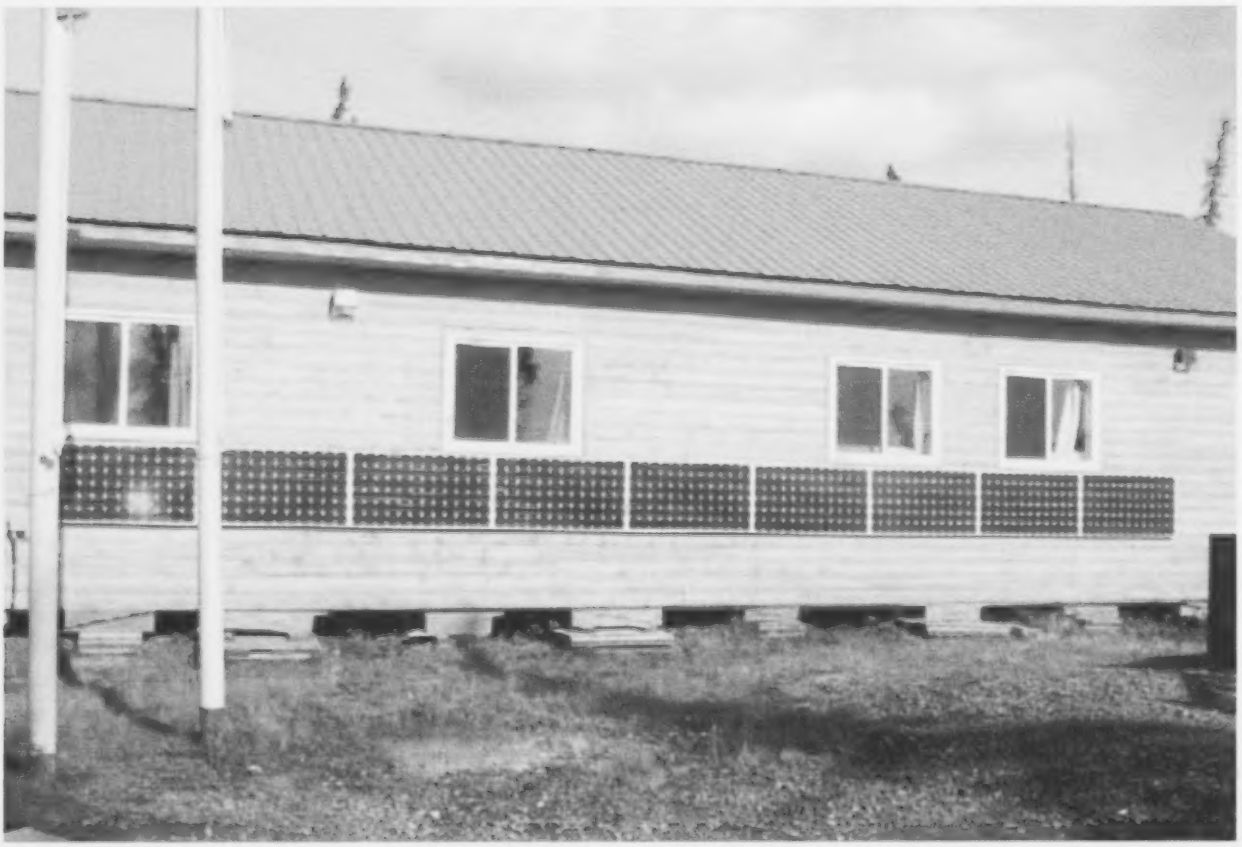
The rated power output of solar collecting equipment is determined under controlled 'Standard Test Conditions' (STC). Different environmental conditions in 'real world situations' can result in production values which are different than the rated STC. A Solar Energy Monitoring Program will be developed to record accurate energy output of solar energy systems under NWT conditions.

Working with public or private users of solar energy technologies, the GNWT will implement web-based solar monitoring systems on grid-connected solar systems that will regularly collect performance data. This will provide a basis for economic modelling under NWT conditions and enhance understanding of the long-term benefits of solar energy systems.

A dedicated public website will be developed to facilitate data reporting and centralize the monitoring of grid-interconnected solar PV systems in the NWT. Production values from each installation will be made available on the website.



Enodah Wilderness Adventures, Off-grid Solar Battery Charging System, Installed 2010 – Photo Credit: Ragnar Wesstrom



Gwich'in Wellness Camp, 1.7 kW Isolated Diesel Grid Interconnection, Installed 2010 – Photo Credit: Matthew Brost

Planning and Implementation

Successful implementation of the Solar Energy Strategy requires ENR to work closely with public power utility companies, communities, business, residents and industry. Key solar projects in the NWT must be assessed for both technical and environmental merit to determine ultimate feasibility.

Initiatives under the Solar Energy Strategy will be coordinated and assessed in a manner consistent with evaluations of other renewable energy strategies and the broader framework of the *NWT Energy Plan* and the *Greenhouse Gas Strategy*.

Implementation of actions outlined in this Strategy requires the involvement, input and support of multiple energy partners. The GNWT is committed to working with these and other partners to advance these initiatives.

Initiatives will be undertaken based on the availability of resources, including those of the GNWT as well as those that can be leveraged from outside partners.

Strategy Review

A review of the Solar Energy Strategy and its implementation, based on an evaluation framework and criteria developed by partners for key initiatives, will be done in the fall of 2017. Revisions to the Strategy will be made to reflect the experience and knowledge gained through carrying out and evaluation actions.

Paulatuk Youth Centre. 5kW Grid Interconneted. Installed 2011 – Photo Credit: Bart Coumont

Angik School, Paulatuk. 2.1 kW Grid-tie. Installed 2011 - Photo Credit: Bart Coumont

Appendix 1
Summary of Actions

Number	Action
1	The Arctic Energy Alliance (AEA) will continue to provide energy information to both public and private sectors.
2	Deliver Solar Energy Workshops through the Arctic Energy Alliance (AEA).
3	Establish a GNWT Interdepartmental Solar Energy Committee.
4	Install visible solar output displays in public buildings with solar collectors.
5	The GNWT, together with power utilities, will develop a comprehensive program for grid-interconnected PV systems.
6	Deploy solar systems sized up to 20 percent of the average load in diesel communities.
7	Investigate ways to deploy solar systems sized at up to 75 percent of the average community load in diesel communities.
8	Continued support for off-gird solar applications.
9	Develop an NWT Solar Energy Monitoring Program for solar electric, solar hot water and solar air heating installations.

For more information, contact
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